Magnolia splendens Urban — Laurel sabino

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Magnoliaceae — Magnolia family

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Magnolia splendens Urban, called laurel sabino in Spanish and magnolia in English, is an evergreen tree species endemic to northeastern Puerto Rico (fig. 1). When mature, laurel sabino supports a narrow, dark-green crown and may reach 25 m in height and 1.2 m in d.b.h. Identifying features include its large leaves that have a spicy taste when bitten into and that are covered with silky gray hairs; a terminal stipule that falls, leaving a ring scar on the branch; long, pointed terminal buds; and large white flowers (*21, 31*). Because the wood was highly regarded for use in furniture and cabinet making, laurel sabino was harvested in the Luquillo Mountains through the early 1950's (*32, 40*).

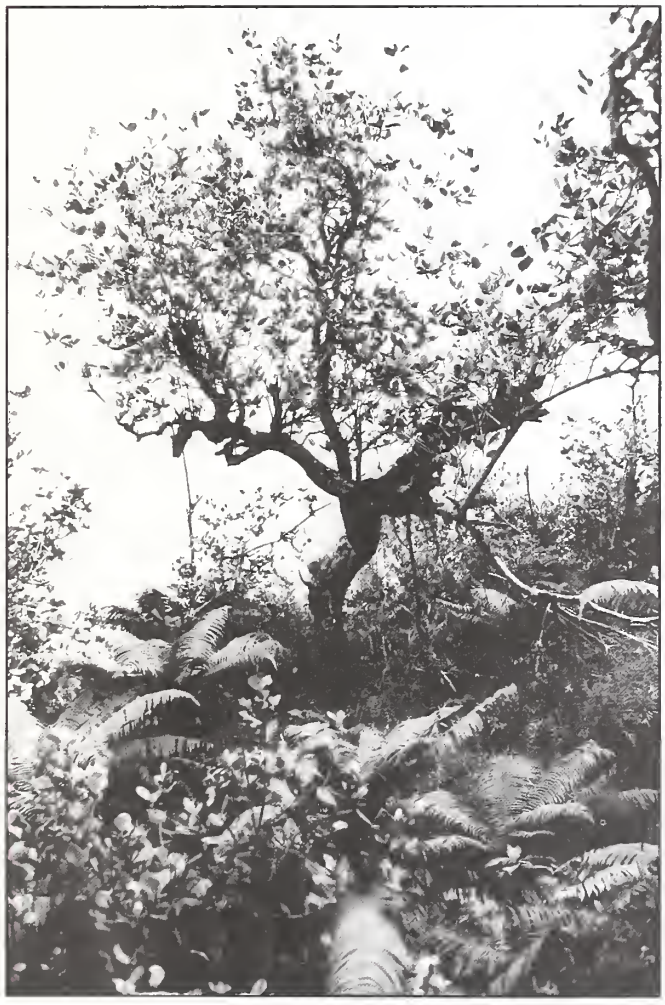

Figure 1.—*Laurel sabino* (Magnolia splendens *Urban) in the dwarf forest of Puerto Rico's Luquillo Mountains.*

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HABITAT

Native Range

Laurel sabino is endemic to northeastern Puerto Rico, growing mainly in the Luquillo Experimental Forest (LEF) (*21, 25*), where it is confined to approximately 10,000 ha of montane forestland at elevations between 200 and 1,075 m (fig. 2). The species appears to be most common in the cool, wet forests that are found at elevations from 600 to 900 m (*36*).

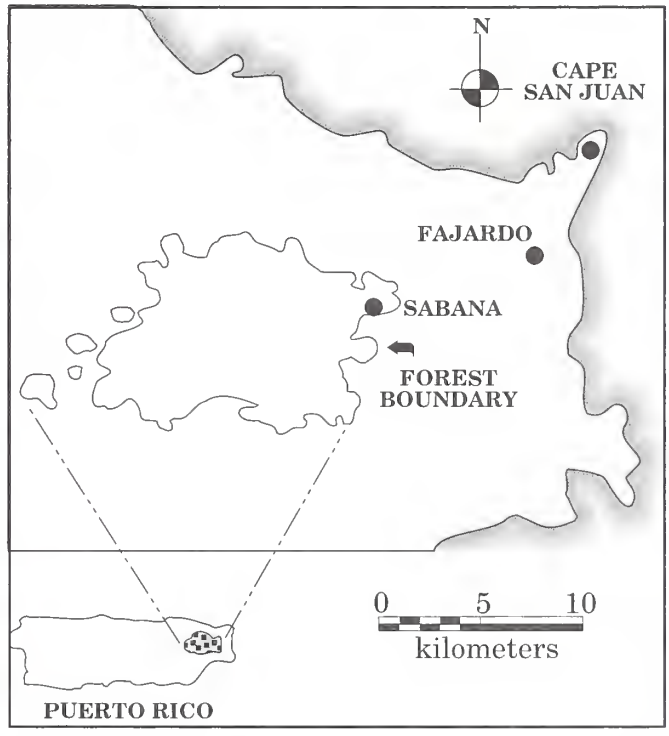

Figure 2.—*Laurel sabino* (Magnolia splendens *Urban) is endemic to northeastern Puerto Rico, growing within the boundaries of the Luquilo Experimental Forest.*

Climate

Laurel sabino grows in four of the LEF's five life zones sensu Holdridge (*17*): subtropical wet forest, subtropical rain forest, lower montane wet forest, and lower montane rain forest (*10*). Rainfall, increasing with elevation, varies from 2500 to more than 4500 mm/yr (*7*). Relative humidity also increases with elevation whereas evapotranspiration decreases. Mean annual temperatures vary between 23 and 19 °C over the same gradient. Hurricanes, most common from July through September in the Caribbean Basin, have had a direct impact on the

LEF at least four times since the early 1700's (*30*). San Cipriano in 1932 and Hugo in 1989 were the most recent storms.

Windward areas in the Luquillo Mountains are wetter and more frequently cloud covered than leeward areas. Moreover, areas above 600 m in the LEF are frequently enveloped in cloud cover even when lower slopes are clear. On the mountain summits, solar insolation is reduced to only 60 percent of that recorded at coastal sites (*3*). All areas where laurel sabino grows are frost free.

Soils and Topography

Laurel sabino grows in acid clay soils, 50 percent of which, in the LEF, are classified as Ultisols and 20 percent, as Inceptisols (5). The Ultisols are deep, highly weathered and leached, with low pH values. The Inceptisols are less weathered and without significant illuviation or leaching. At the highest elevations in the LEF, the soil is composed of a mucklike surface 25 to 30 cm thick (*23*). Laurel sabino grows on all topographic positions (*42*) but appears more frequently on ridges and slopes than in ravines (*40*).

Studies conducted in different parts of the LEF provide insights on laurel sabino's distribution. In the Bisley watershed, which descends to 260 m in elevation, laurel sabino trees were rare (*1*). At the upper extreme, in the dwarf forest of Pico del Oeste above 1,000 m, only one specimen was recorded (*19*). In the Baño de Oro Research Natural Area, a 745-ha tract extending from 245 to 1,025 m in elevation to the windward of the summits, 3,020 trees were sampled on 30 plots (*44*). Laurel sabino comprised 1.2 percent of the total as follows (stems/0.15 ha): 1 at 350 m, 2 at 450 m, 4 at 550 m, 5 at 600 m, 7 at 650 m, 7 at 700 m, and 11 at 750 m (*44*). None were recorded at elevations of 850, 950, or 1,050 m.

Sampling of a colorado forest between 620 and 970 m to the windward and leeward of the Luquillo Mountain summits showed that laurel sabino was generally more common on windward exposures (*40*), particularly at elevations between 600 and 700 m. In contrast, at a 900-m elevation, laurel sabino appeared more common on leeward exposures.

Associated Forest Cover

Laurel sabino grows mainly in the lower montane rain forest and montane rain forest sensu Beard (*4*), locally called the tabonuco and colorado forests, respectively (*36*). These forest types are separated mainly along the 600-m contour in the LEF. Laurel sabino also grows in the dwarf forest (*4, 36*), mostly at elevations under 1,000 m (*19*). It is also a component of the palm forest (*4, 13, 36*) commonly found at elevations above 500 m in ravines and on steep, windward-facing slopes. The major tree species that grow in association with laurel sabino in these different forest types are listed in table 1.

Table 1.—*Associated forest cover of major tree species growing with laurel sabino (*Magnolia splendens *Urban) in Puerto Rico*

Location	Elevation	Rainfall	Principal associated species*	Source
	- Meters -	*mm/yr*		
Bisley (tabonuco forest)	260-450	3300	*Sloanea berteriana* *Prestoea montana* *Dacryodes excelsa* *Cyathea arborea*	(*1*)
Tabonuco forest	300-500	~3000	*Euterpe globosa* *Cecropia peltata* *D. excelsa* *Micropholis garciniaefolia*	(*36*)
Colorado forest	600-900	~4000	*E. globosa* *M. garciniaefolia* *Calycogonium squamulosum* *Croton poecilanthus*	(*36*)
Palm forest	750	~4000	*P. montana* *M. garciniaefolia* *C. poecilanthus* *Calycogonium squamulosum*	(*13*)
Dwarf forest	>900	~4500	*Ocotea spathulata* *Tabebuia rigida* *M. garciniaefolia* *Clusia grisebachiana*	(*19*)

*Species listed in order of abundance; *Prestoea montana* is the new name for *Euterpe globosa*.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Laurel sabino flowers have three whitish-green sepals about 3.2 cm long and six or more white spreading petals about 3.8 cm long. The petals are broad and rounded at the apex (*21*). Stamens are numerous and measure about 1.3 cm. Pistils, also numerous, are about 1.0 cm in length and contain a one-celled ovary and curved style that are spirally arranged in a conelike center about 1.6 cm long.

The elliptic fruits are greenish and conelike, measuring about 3.2 cm long and 2.2 cm wide and containing numerous seedpods (follicles) that split open. Each seedpod usually contains two triangular, red, fleshy seeds slightly more than 0.6 cm long that are attached to the seedpods by threads.

Flowering is mainly from April to September. Laurel sabino's fragrance is similar to that of *M. hypoleuca* or *M. sieboldii* (*11*). Fruits are produced from spring to winter (*21*).

Seed Production and Dissemination.—Information from studies conducted in Puerto Rico during the late 1930's showed that the seed production of laurel sabino was poor (*40*). Of the few seeds collected, none germinated. More recently, a test of 72 seeds taken from 2 trees in the colorado forest gave the following results: 32-percent germination of 41 seeds sown immediately and no germination of 31 seeds subjected to a 3.5-month cold treatment (*12*).

Many authors have noted that only a small percentage of the seeds of the genus *Magnolia* are perfectly developed (*18*). Moreover, even the germination of perfectly developed seeds is difficult because the seedcoat is impermeable and lignified. *Magnolia's* seedcoat is aromatic and appears to be attractive to birds, the apparent dispersal agents (*18*).

Seedling Development.— Only 7 of the 13 germinated seeds survived to 6-month-old seedlings in the aforementioned germination study (*12*). They were of "generally poor quality" and extremely slow growing.

Vegetative Reproduction.— Laurel sabino trunks typically produce numerous new shoots or suckers (*21*). Much of this vegetative reproduction may be attributed to recovery after tropical storms or hurricanes (fig. 3).

Figure 3.—*Laurel sabino (*Magnolia splendens *Urban) in the dwarf forest of Puerto Rico's Luquillo Mountains. Note the numerous sprouts at the base of the tree, possibly resulting from the effects of Hurricane Hugo in September 1989.*

Sapling and Pole Stage to Maturity

Growth and Yield.— The largest recorded laurel sabino in Puerto Rico measures 1.53 m in d.b.h. and 21.0 m in height and has a crown spread of 10.3 m.[1] Only a few laurel sabinos, however, attain a large size in Puerto Rico.

Observations of tree growth are available from several permanent plots in the LEF. The d.b.h. growth rates spanning 5, 10, and 30 years for all laurel sabino trees combined in unthinned stands varied from 0.07 to 0.10 cm/yr, regardless of forest type (table 2). Both short- and long-term growth rates were about equal. Dominant and codominant trees in a thinned colorado plot, however, showed d.b.h. growth rates between 0.15 and 0.21 cm/yr for 35 years (table 2). The d.b.h. growth rate is most rapid in the dominant crown class, generally declines through the codominant and intermediate classes, and is least rapid in the suppressed class, with or without previous thinning (table 2).

Growth data from undisturbed plots in the colorado forest were used to estimate laurel sabino's age from its d.b.h. in natural conditions (*40*). These estimates were as follows: 10 cm in d.b.h, 85 years; 20 cm, 140 years; 40 cm, 300 years; and 65 cm, 500 years.

Rooting Habit.— The roots of laurel sabino in the LEF grow in association with endotrophic mycorrhizae that probably help trap nutrients (*9*).

Reaction to Competition.— Laurel sabino is an uncommon species in the LEF. During the 1940's, it comprised only 1.0 percent of the stems greater than 10 cm in d.b.h. on 10 ha of virgin tabonuco forest and 1.3 percent of the stems greater than 10 cm in d.b.h. on 10 ha of virgin colorado forest (*36*). In another summary of data, laurel sabino ranked as the 33rd most common of the 80 species tallied in both forests (*6*).

Laurel sabino has many of the attributes of a gap opportunist, or a species whose reproduction is tied to forest openings (*40*). The openings may result from isolated treefall or from major forest disturbance caused by high winds or hurricanes. This classification was derived by comparing the survival of seedlings and understory trees in a closed forest, seed size, and the specific gravity of wood for species that reach the canopy in colorado forest. Laurel sabino's composite score, based on the absence of seedlings, paucity of understory trees, generally small seeds, and medial weight for the wood ranked it as 4th on a scale that ranged from 1, or most secondary, to 20, or most primary, among the 20 species studied (*43*).

Another characteristic of gap species is their d.b.h. distribution pattern: numerous stems in the smallest d.b.h. class and fewer stems, but a relatively constant number of stems, in each of the larger d.b.h. classes (*40*). In 1946, laurel sabino's d.b.h. class distribution on 3.2 ha of colorado forest was that of a gap species; that is, there were numerous stems in the smallest d.b.h. classes (e.g., 5 and 15 cm), whereas all larger d.b.h. classes (25 to 75 cm) contained only a few stems in

[1]Register of champion trees of Puerto Rico. Available at the International Institute of Tropical Forestry, P.O. Box 25000, Río Pedras, PR 00928-2500.

Table 2.— *Comparative growth data for laurel sabino* (Magnolia splendens *Urban*) *growing in Puerto Rico*

Plots	Elevation	Trees sampled	Duration	D.b.h growth	Source
	-Meters -	*Number*	*- Years -*	*- - - cm/yr - - -*	
Tabonuco					
Ridge	400	5	30	0.07	(*38*)
Slope	570	2	30	0.08	(*38*)
Colorado *					
Undisturbed	600-900	38	5	0.10	(*33*)
		37	10	0.10	(*34*)
	700-750	42	30	0.09	(*38*)
Colorado *					
Undisturbed	600-900	26	35	0.11 ± 0.02†	(*39,40*)
		9	35	0.06 ± 0.02†	
		17	35	0.07 ± 0.01†	
		24	35	0.04 + 0.01†	
Colorado					
Thinned	670	4	35	0.21 ± 0.06†	(*40*)
		3	35	0.15 ± 0.02†	
		2	35	0.05 + 0.04†	
		1	35	0.01†	

* Same group of plots, partially measured after 5, 10, and 30 years, and completely measured after 35 years.

† Data for dominant, codominant, intermediate, and suppressed stems in descending order; measured after 35 years.

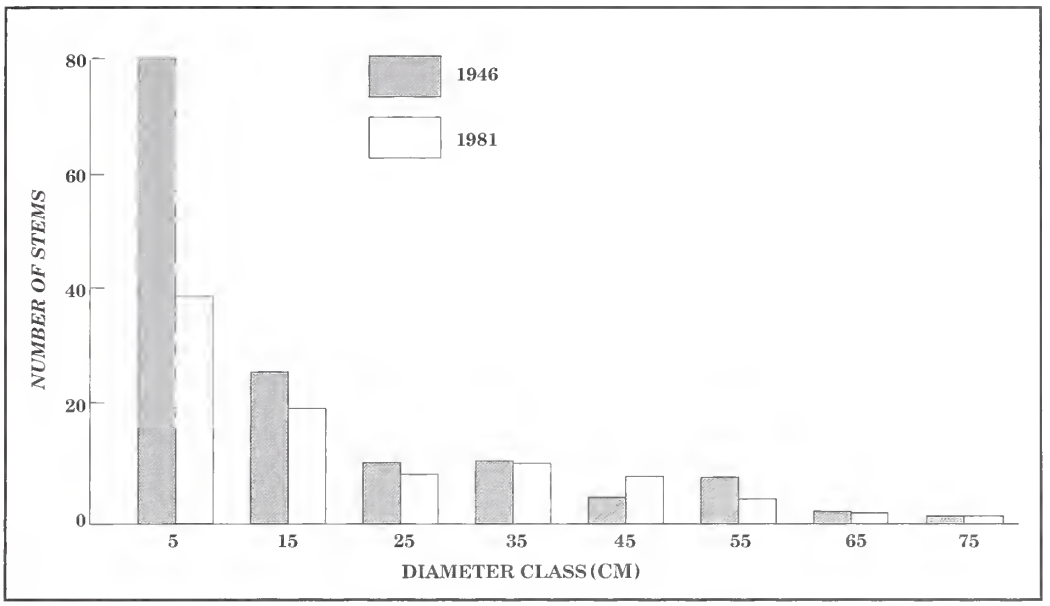

Figure 4.—*D.b.h. class distribution for laurel sabino (*Magnolia splendens *Urban) in 1946 and 1981 on permanent plots totaling 3.2 ha in the colorado forest. D.b.h. classes are: 5 cm (4.1 - 9.9 cm); 15 cm (10.0 - 19.9 cm); and in 10-cm increments through 75 cm (70.0 - 79.9 cm).*

each class (fig. 4). By 1981, stem numbers in the smallest d.b.h. class had declined by half. The larger classes, however, remained virtually constant in stem numbers. Two observations can be made from these data. First, in relatively open stands previously disturbed by hurricanes, laurel sabino regenerates and grows into smaller d.b.h. classes. As the forest closes during recovery, however, the smallest laurel sabinos are shaded by competing species. Second, once laurel sabino attains a d.b.h. of about 10 to 15 cm, probably at canopy level, it appears to survive well into maturity.

Information from permanent plots in the tabonuco and colorado forests provides additional insights into laurel sabino's reaction to competition. In 1946, 14 years after the passage of Hurricane San Cipriano, laurel sabino accounted for 2.6 percent of the stems and 4.6 percent of the basal area tallied on seven natural forest plots in the colorado forest (41). By 1981, laurel sabino's proportion of stems and basal area had declined to 1.7 and 4.4 percent, respectively. During the same period, laurel sabino's mortality exceeded ingrowth. Stem numbers decreased by 35 percent and its basal area by 10 percent.

In contrast, on a thinned tabonuco plot, laurel sabino's ingrowth exceeded mortality, resulting in a 33-percent increase in stems and a 50-percent increase in basal area during 35 years (*40*). Moreover, the d.b.h. growth of laurel sabino on a thinned colorado plot, particularly for dominant and codominant stems, was considerably greater than on the undisturbed control plots (table 2). In summary, relatively open forests, which have conditions created by thinnings or openings immediately after hurricanes, are more favorable for the germination, growth, and survival of laurel sabino than closed forest conditions.

Ecological data on laurel sabino is available from studies conducted in the LEF. These include average leaf weights and specific leaf areas (*28, 45*); information on biomass and nutrient content for leaves, branches, and trunks (*29*); and the distribution of chlorophyll in tree crowns (*27*).

Damaging Agents.— Molds and sap-staining fungi seldom develop during the air-drying of laurel sabino (*22*). The wood, however, is susceptible to attack by the dry-wood termite, *Crypotermes brevis* Walker (*46*), and is very susceptible to decay when in contact with the ground (*22*). Two species of Homoptera, *Bothriocera undata* and *Neocolpoptera monticolens*, have been recorded on laurel sabino (*24*).

Laurel sabino suffered crown damage during Hurricane San Felipe of 1928 and did not recover for 6 months (*2*). More recently, losses of foliage, branches, boles, and total biomass were recorded for laurel sabino after the passage of Hurricane Hugo (*14*). Undoubtedly, most mature specimens of laurel sabino have been exposed to the ravages of numerous storms during their centuries of growth.

The continual harvest of laurel sabino from 1930 through the early 1950's eliminated many large specimens, suggesting that the species had been removed more rapidly by humans than it could replace itself in nature (*8, 21*). The removal of much of laurel sabino's seed source by logging probably compounded its problems of poor seed production and germination in the remaining population. Moreover, the recovery of the LEF forests subsequent to Hurricane San Cipriano of 1932 resulted in a closed canopy forest (*39, 41*), a condition that is not favorable to the regeneration of laurel sabino (*40, 43*). By the mid-1970's, the species was tentatively included on Puerto Rico's list of endangered, endemic plant species (*47*). Today, however, there is not a general consensus that the species is endangered.

SPECIAL USES

Laurel sabino is a hard, moderately strong wood with a specific gravity of 0.59 g/cm^3 (*21*). The heartwood seasons from an olive green to brown. The sapwood is whitish in color. Growth rings and frequent dark streaks give the wood a very attractive appearance (*22*). The grain is straight to wavy,

and the texture fine and uniform.

The wood is easy to air-dry. It shrinks moderately in all directions and dries rapidly with only minor degrade (*22*). The wood saws and machines easily; planing and sanding are fair; and shaping, turning, boring, mortising, and resistance to screw splitting are all good.

Laurel sabino's excellent wood qualities made it a prime species for furniture manufacture and cabinet work for many years in Puerto Rico (*16, 22, 26, 37*). It is also suitable for decorative veneer, plywood, millwork, durable construction, boat planking, and general carpentry.

Although the Puerto Rican parrot usually nests in cavities of the swamp cyrilla (*Cyrilla racemiflora* L.) in the LEF, cavities in laurel sabino have also been used (*32*). Use of laurel sabino for nesting may have been more frequent in the past when both the tree and parrot were more common. The Puerto Rican parrot has also been observed eating new laurel sabino foliage, often still unfurled (*32*).

Many species of the genus *Magnolia* are highly regarded as ornamentals; therefore, laurel sabino may also be suitable as an ornamental (*21*). However, its hardiness outside of its limited range in the cool, wet forests of the LEF has not been tested (*12*). Laurel sabino's spicy leaves have been used as a condiment (*21*).

GENETICS

The Magnoliaceae contain 12 genera and about 220 species of trees and shrubs, 80 percent of which are distributed in temperate and tropical Southeast Asia (*15*). The remainder grow in temperate and tropical America. Several of the characteristics of the Magnoliaceae, such as the spiral arrangement of floral parts, are considered primitive by many authors (*15*).

The known Magnoliaceae in the West Indies consist of eight native and one introduced species of *Magnolia*, three native species of *Talauma*, and two introduced species of *Michelia* (*18*). All native West Indian Magnoliaceae are trees. The West Indian species of the genus *Magnolia*, all endemics, are considered as a natural group.

The nuclear volume of laurel sabino was estimated at 314.0 ± 42.3 cubic microns (*20*). *Talauma splendens* (Urban) McLaughlin is a botanical synonym (*18, 21*). *Magnolia portoricensis* Bello, a closely related endemic, grows in the Cordillera Central of Puerto Rico (*21*).

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